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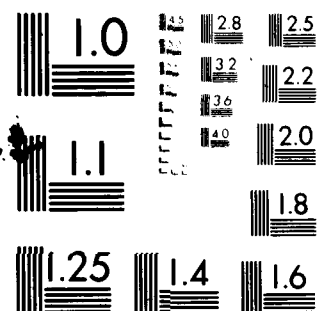
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# ISSUES IN NAVY MANPOWER RESEARCH AND POLICY: AN ECONOMIST'S PERSPECTIVE

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# ISSUES IN NAVY MANPOWER RESEARCH AND POLICY: AN ECONOMIST'S PERSPECTIVE

John T. Warner



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## ISSUES IN NAVY MANPOWER RESEARCH AND POLICY:

### AN ECONOMIST'S PERSPECTIVE

#### INTRODUCTION

Navy manpower problems are a continuing topic of study at CNA, RAND, NPRDC, and other institutions. Despite this research, many problems remain. For example, the quality of accessions has been quite variable in recent years. In FY 1976,<sup>1</sup> the Navy recruited 46,600 male high school graduates in the upper mental groups (I-III A), 50.7 percent of male non-prior service (NPS) contracts written in that year. By FY 1979, the number had fallen to 28,100, or 41.6 percent of FY 1979 male NPS contracts. In FY 1981, it bounced back to 44,025 or 56.9 percent. This variability in the quality of accessions raises serious concern whether the Navy will be able to satisfy its accession demands for high quality people in the 1980s, in view of current plans to expand from a 450-ship to 600-ship Navy and a decline in the military eligible youth population.

Another problem is high losses of personnel before they complete their initial term of service. This first-term attrition increased from 32 percent in FY 1972 to 38 percent in FY 1977. Since then it has declined, but still remains near its FY 1972 level.

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<sup>1</sup> October 1975 - September 1976.

A third problem is a continuing shortfall of petty officers. Since the mid-1960s, the Navy has been short more than 20,000 petty officers. This problem has persisted despite a substantial decline in enlisted end strength.

These statistics illustrate the magnitude of several of the Navy's manpower problems. The purpose of this paper is to summarize what we know about Navy manpower problems and what we don't, and to point out areas where future work would be most profitable. To do this, I first provide a framework for thinking about Navy manpower problems. Naturally, I take the economist's approach to specifying such a framework. The framework involves viewing the Navy manpower system as a market and discussing issues in terms of supply and demand. Compensation and personnel policies are treated as the mechanisms which equilibrate the supply and demand sides of the market. Finally, I discuss the policy issues, highlighting the one's I think are most serious.

Along the way, I will develop two major themes. The first is that more is known about the supply side of the market than about the demand side. The reasons are several. For one, the data for quantitatively measuring supply and estimating the relationship between it and factors such as pay are more readily available. Productivity and hence demand factors have proven so much harder to measure that most analysts have given up in despair. For another, only with the advent of the AVF and an increased stress on "cost-effectiveness" has there been any emphasis

on acquiring information regarding such factors as the relative productivity of first-termers and careerists or men and women. Concurrently, the increasing sophistication of weapons systems and other equipment has created a need for more information about the relationship between personnel quality and productivity.

The second theme is that while analysts can point to many apparent inefficiencies in the Navy manpower system, the analytical tools for evaluating the extent of these perceived inefficiencies are underdeveloped. This deficiency exists both because the analytical models required to fully evaluate various policy changes are underdeveloped and because the parameter inputs such models require are uncertain. A result is that in the absence of convincing evidence otherwise, policymakers usually argue for a continuation of the status quo. A case in point, discussed later, is the recent debate over proposed changes in the military retirement system.

#### ECONOMIC FRAMEWORK FOR ANALYZING NAVY MANPOWER PROBLEMS

Our analysis of Navy manpower problems relies on standard microeconomic theory. The conceptual framework says if  $R = \bar{R}$  is the required level of readiness or mission capability (however difficult this is to measure), then the Navy should choose the combination of inputs that minimizes the cost of readiness level  $\bar{R}$  subject to other constraints such as the prohibition against the use of women on ships and the need for a shore rotation base for personnel in sea-going ratings. Inputs include ships, supplies, and manpower. Manpower, may



be characterized in terms of quality, skill or experience level, sex, etc.

Theory tells us that the optimal input mix is found where the ratios of the marginal contributions to readiness of the different inputs (in the economist's jargon, marginal productivity) equal the ratios of the marginal costs. This proposition is illustrated in figure 1, using first-term personnel and careerists as the alternative inputs being varied. The readiness curve R shows all the combinations of first-term and career personnel that yield the same level of readiness. The slope of this curve at any point is  $-\frac{MP_{FT}}{MP_C}$ , where  $MP_{FT}$  is the marginal productivity of first-termers and  $MP_C$  is the marginal productivity of careerists. The slope of this curve decreases as first-termers are added and  $MP_C$  increases as careerists are reduced. The convex curve labeled P shows the relative marginal cost  $\frac{MC_{FT}}{MC_C}$  of any given combination of first-termers and careerists. The curve becomes steeper as first-termers are added since  $MC_{FT}$  rises with the number of first-term personnel (due to rising marginal recruiting costs) and  $MC_C$  declines as careerists are reduced (due to declining marginal bonus and retirement costs). The optimal (cost-minimizing) first-term/career mix is where  $\frac{MP_{FT}}{MP_C} = \frac{MC_{FT}}{MC_C}$  or where  $\frac{MP_{FT}}{MC_{FT}} = \frac{MP_C}{MC_C}$ . This is point A in figure 1. Other points on the readiness curve  $\bar{R}$  can only be reached at higher costs. This analysis says that the Navy should alter its use of each input until the extra output (readiness) obtained by the last dollar of spending on each input is the same.

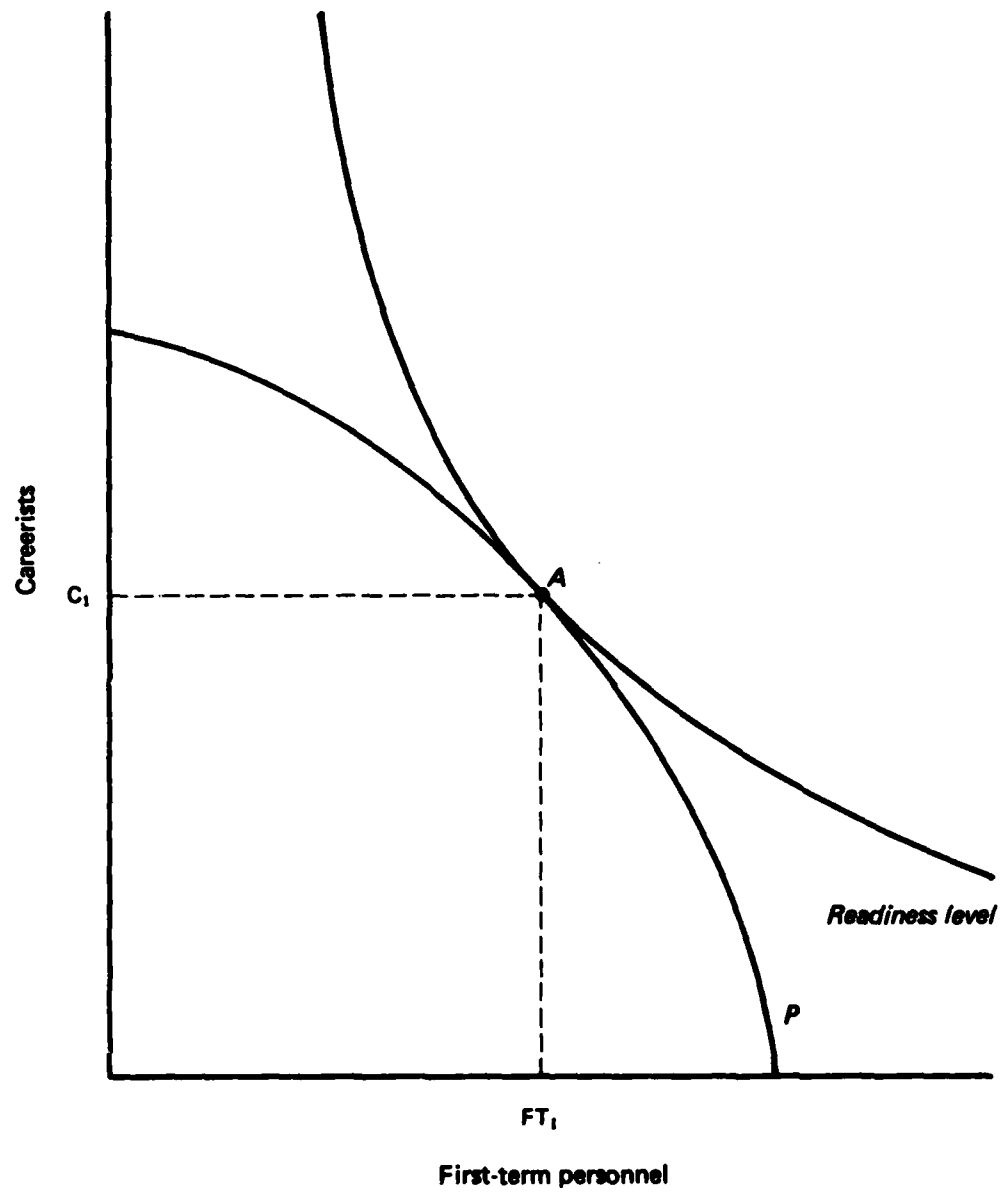


FIGURE 1

Although figure 1 is two-dimensional, the input choice problem is really multidimensional. While complex problems may arise when the input choice problem is multidimensional, the above discussion does provide a guide to decision-makers. The management problem is really to gather information on the marginal productivities and marginal costs of different inputs and to determine, as best can be done, the right combination of inputs. In the context of manpower, the marginal costs of personnel with different attributes are derived from their supply functions. Again, in the context of manpower, the marginal productivities of personnel with different attributes depend on the job to be performed and the equipment with which personnel must work. The interaction between personnel and equipment is considered in greater detail in the section on demand. I now turn to the evidence on military labor supply.

#### SUPPLY

What do we know about the supply side of the Navy manpower market? To answer this, I first discuss initial accession supply, then supply at the first, second, and later reenlistment points. At any point from the initial accession point onward, we can conceptualize the quantity supplied as a function of pecuniary and non-pecuniary factors.

##### Accession Supply

Beginning with the Gates Commission study by Gilman [1], there have been many studies of accession supply. More recent studies include

those of Jehn and Shughart [2], Grissmer [3], Fernandez [4], Goldberg [5, 6], and Morey [7]. While differing in data and model specification, these various studies attempt to estimate accessions as a function of relative pay, the number of recruiters, advertising expenditures, civilian unemployment, and other factors. Among the other factors that have loomed important in the late 1970s are the elimination of the GI Bill and substitution of the cheaper Veteran's Educational Assistance Program (VEAP) and increased funding of job training programs such as the Comprehensive Employment and Training Act (CETA). Relationships estimated in this body of work have important uses for both policy formulation and forecasting future supply. A problem in empirical analysis is trying to identify the supply of recruits as distinct from the demand. Thus, most studies analyze accessions in groups considered to be supply-limited (e.g., male high school graduates (HSGs) in mental groups I-III A). An important question for compensation policy is whether different groups respond differently to various incentives.

Results of studies by Grissmer, Fernandez, and Goldberg are summarized in table 1. For the most part, these studies found that various supply determinants operate in the expected direction. Higher military pay, higher unemployment, more recruiters, and more advertising all increase male HSG accessions. However, there is considerable variation in the estimated effects of these variables.

Consider first the effect of unemployment. Although Fernandez' estimate is much larger than Grissmer's or Goldberg's, all estimated the

TABLE 1

MALE NPS HIGH SCHOOL GRADUATE  
ACCESSION ELASTICITIES<sup>a</sup>

	Grissmer <sup>b</sup>		Fernandez <sup>c</sup>			Goldberg <sup>d</sup>
	<u>I-II</u>	<u>III</u>	<u>I-II</u>	<u>IIIA</u>	<u>IIIB</u>	<u>I-IIIB</u>
Pay	.94	1.55	.48	.02	.03	1.02
Unemployment	.50	.35	.72	.77	.83	.36
Recruiters	NE <sup>e</sup>	NE	NE	.60	.66	.48
Advertising	NE	NE	NE	NE	NE	.05

<sup>a</sup>The elasticity is the percentage change in accession supply for a one percent change in the given factor, e.g., pay.

<sup>b</sup>[3]

<sup>c</sup>[4]

<sup>d</sup>[6]

<sup>e</sup>NE = not estimated

effect of unemployment as quite substantial. Goldberg found that each one percentage point decline in the civilian unemployment rate reduces male HSG accessions by about 3,000, or about 5 percent of the FY 1980 goal. Fernandez estimated an even larger effect.

Estimates of pay effects vary considerably. In both the original Goldberg study [5] and the Fernandez study, pay has a low, statistically insignificant effect on accessions. Grissmer's estimates [6] using FY 1970-75 data and the more recent Goldberg estimate using FY 1974-80 data are much higher, and are statistically significant. In my view, the larger estimates are more believable.<sup>1</sup>

One "maintained hypothesis" has been that lower mental group individuals are more responsive to pay changes than higher mental group individuals. The work by Grissmer lends some support to this hypothesis, although it does not indicate whether different groups respond differently to other inducements (e.g., educational

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<sup>1</sup>The earlier Goldberg study and Fernandez study were done using aggregate time series data during the AVF period. In these studies, the only variation in relative military pay is a gradual downward trend over the sample period. Not only is the variation in pay small, but the trend in pay is highly collinear with other factors during the sample period. There is also considerable measurement error in relative pay. Such problems will bias estimated pay effects toward zero. Goldberg's more recent work pools time series and cross-section data across recruiting districts for the period FY 1977-79 and it constructs civilian pay by recruiting district using the earnings of youth, not earnings of all workers. In this data there is considerably more variation in pay and pay is not so collinear with other factors. As a result estimated pay effects are considerably stronger. Notably, the Grissmer study used data from a period in which there was a very large change in relative first-term pay and he estimates substantial pay elasticities.

incentives). Goldberg's most recent work does not support the hypothesis. It does show that higher quality people respond more strongly to educational benefits.

The estimated effects of recruiters and advertising are also somewhat uncertain. The original Goldberg estimate of recruiter productivity was quite high; his more recent estimate is closer to Fernandez' and the earlier studies previously cited. Only Goldberg [5,6] and Morey [7] have estimated the effect of advertising, which both found significant for male HSG accessions. Yet, again, the estimates are highly variable. It is not clear from these various estimates which policy variable, recruiters or advertising, has the lower marginal recruiting cost.

Regardless of the variability of the estimated effects of pay, recruiters, advertising, it seems clear that additional recruiters and advertising produce extra accessions more cheaply than does higher pay. Gaining more accessions by raising pay costs about five times more than gaining additional accessions via more recruiters or advertising. The reason for this difference is that a general pay raise must be given

to all previous recruits as well as additional ones attracted by the pay raise.<sup>1</sup>

Enlistment bonuses represent one compensation tool that can be targeted at specific groups of potential recruits. While they do represent a way of increasing enlistment incentives among some groups without having to raise pay for all incoming enlistees (i.e., practicing wage discrimination), their effects are yet to be thoroughly analyzed. Enlistment bonuses have generally been rather small, and they have not been well advertised. In fact, it is not clear whether they have expanded enlistment supply. Their effect may have been to allocate those who would have enlisted anyway from one rating to another. (This is not to argue that bonuses shouldn't be paid, only that their effects needed to be more thoroughly studied.)

Until recently, like enlistment bonuses, the supply effect of educational incentives — in particular the elimination of the GI Bill program in its replacement by the VEAP — had not been quantified. VEAP is a voluntary program whereby the service member and the government each make contributions into a educational fund. Distinguishing features of the VEAP program are that the contributions do not draw

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<sup>1</sup>In the economist's lingo, the Navy is a monopsonist since it faces an upward-sloping accession supply curve. The monopsony problem is that marginal accession cost exceeds the pay of additional recruits unless the Navy can practice perfect wage discrimination, i.e., pay each recruit his supply price or reservation wage. Note that if the Navy cannot (perfectly) wage discriminate, some recruits will inevitably be paid more than their reservation wage. These recruits are said to earn "rents," an important concept I will say more about below.



interest, and the fund is not adjusted for inflation. Fernandez [8] shows that under a variety of realistic assumptions, VEAP is a much less generous program than the GI Bill. Replacement of the GI Bill program by VEAP reduced the present value of a 4-year enlistment by between 15 and 18 percent.<sup>1</sup> Since, historically, about 65 percent of military enlistees have eventually used the GI Bill, this program change reduced the expected present value of an enlistment by between 10 and 12 percent. Using a supply elasticity of 1.0, one would predict a roughly comparable percentage drop in accessions (at least high quality accessions) due to this program change. An extension of Goldberg's analysis confirmed an effect in this range.

Other factors were also operating to reduce accessions, factors on both supply and demand sides of the market. On the supply side were falling relative pay and civilian unemployment. On the demand side, quotas were falling also, (possibly) inducing less intensive efforts by recruiters.<sup>2</sup> In addition, there is anecdotal evidence that in FY 1978 the Navy began enforcing more stringent mental group testing standards in an effort to reduce first-term attrition. Mental group IV applicants who would have been classified in mental group III by earlier, easier

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<sup>1</sup>Computed from table 3 (cases A2 and B) and table 6 of Fernandez (reference 8). The former percentage assumes a 20 percent personal discount rate, the latter percentage a zero discount rate. These comparisons assume that GI Bill benefits are fully inflation protected (a reasonable assumption from past history).

<sup>2</sup>Goldberg [5] finds that male I-III HSG accessions are not independent of the recruiting goal, indicating that goal itself may have an important effect on the number of high quality accessions.

tests, were now rejected. In addition, a policy that 83 percent of chargeable accessions should be in mental group I-III and 76 percent should be high school graduates (HSGs) was enforced. Such rules had been in effect previously with varying degrees of stringency — they were usually relaxed when shortfalls persisted for any length of time. This time the rules were maintained even in the face of 10 percent chargeable shortfalls. (At the start of FY 1980 they were relaxed somewhat because of the tight recruiting situation and Congressional pressure on the Navy to recruit more minorities.)

It would be important to know the link between accession supply and federal minimum wage policy. Theory suggests that higher minimum wages may serve to reduce the supply of high quality youth but increase the supply of lower quality youth. They do so by increasing the incentives of private sector employers to hire more productive workers to the exclusion of less productive workers. While such a relationship is quite subtle, and might be difficult to test, knowledge of this relationship would nevertheless be useful.

#### First-Term Attrition

Despite the expectations of the Gates Commission, one of the major problems areas with the AVF has been high first-term attrition. Consequently, much research has focused on what to do about it. Much less research has been done on the reasons why people leave. Research directed at controlling attrition has focused on devising improved selection procedures and designing better classification and assignment

techniques. Most of the work focusing on improved selection procedures has been conducted by Lockman and various colleagues [9-12].

Lockman's original work related the chance of surviving one or more years of service [9] to such background characteristics as education, mental group, age, and dependency status. More recent work (e.g., Thomason [12]) incorporated what happens to people after they enter service. Hence, this work relates survival chances to type of training (A-school vs. General Detail (GENDET)), rating, type of ship served on, other "in-service" factors, and background characteristics. The research on attrition has established that high school graduation is the factor most strongly related to chances of survival. HSG status seems indicative of motivation and persistence. This HSG-non-HSG difference is consistent and reasonably independent of other factors. Other factors related to chances of survival do not appear as stable. Lockman [9] found that survival chances increase with mental group, but later work found that the relationship depends on the jobs to which people are assigned. In higher skill ratings, the relation between survival chances and mental group is strong; in lower skill ratings it is weaker. In GENDET jobs, survival chances are greatest for lower mental

group HSGs. Possibly because of boredom, more able HSGs do not survive as well in unskilled jobs as less able HSGs.<sup>1</sup>

Many critics of the AVF point to high first-term attrition as evidence of its failure. While attrition has been higher than predicted, we should recognize that (1) much of the higher attrition results from easier discharge policies, and (2) first-term attrition is considerably lower than turnover rates among similarly-aged individuals in private sector jobs. Policy changes that might reduce first-term attrition are considered below.

#### First-Term Reenlistments

Aside from initial enlistments, first-term reenlistment behavior has perhaps been studied more than any other element of supply. Among the studies relating pay to first-term reenlistments is the study for the Gates Commission by Grubert and Weiher [13], and the more recent work of Kleinman and Shughart [14], Enns [15], Warner and Simon [16], and Rodney, et al. [17].

These studies all estimate first-term pay elasticities (i.e., the percentage change in the first-term reenlistment rate (FTRR) for a given percentage change in second-term pay). Yet they vary considerably in data and technique. Some studies relate pay to FTRR via a linear

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<sup>1</sup>However, while their survival chances are lower than those of either group of HSGs, it was found that higher mental group non-HSGs have higher survival chances than lower mental group non-HSGs.

probability function; others use a normal or logistics probability function.<sup>1</sup> Studies conducted before Warner and Simon [16] and Rodney et al. [17] used cross-section data, where retention rates by rating represent the units of observation. This procedure has limitations. First, only one "average" pay elasticity can be estimated, which means that we cannot determine whether personnel in various ratings respond differently to pay changes. Second, there is "simultaneous equations bias" since bonus levels (and hence pay) are a function of retention rates as well as retention rates a function of pay. Thus, it is difficult to separate the cause of higher bonuses from the effect. This last problem implies that pay elasticities will, in general, be understated.

The Warner-Simon and Rodney, et al., studies attempt to alleviate these problems by performing separate analyses for different ratings/occupation groups using data on individuals over several years of the AVF era. Problems except the last one are handled by their procedure. The problem of simultaneous-equations bias may still be

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<sup>1</sup>The linear model implies a uniform taste distribution; the others imply a bell-shaped taste distribution. Note that the linear models imply a constant effect of pay changes; normal or logistic models imply larger changes in FTTR for a given pay change as FTTR approaches .5 . A normal or logistics distribution is generally considered to be theoretically more appropriate.

present; my feeling is that it is more severe in their second-term than their first-term results.<sup>1</sup>

Despite the differences in data and methodology, the various studies are surprisingly consistent in their findings. All conclude that the relationship between first-term retention and second-term pay is positive and statistically significant. At a base reenlistment rate of 20 percent, the "average" estimates of studies prior to Warner-Simon range from 2.0 (Enns) to 4.0 (larger estimate by Kleinman-Shughart). The central tendency in these estimates is 2.5.

Warner and Simon estimate separate reenlistment equations for 29 ratings/occupation groups. Overall, their results square quite well with the average estimates from previous studies. Yet, the results suggest considerable variation across occupation groups in the responsiveness to pay changes. In general, responsiveness to pay appears to be the lowest in the sea-going ratings and higher for rating groups with little sea duty. The results suggest that larger pay changes are required to effect a given change in FTRR in the sea-going

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<sup>1</sup>Between FY 1974 and FY 1978, much of the variation in Navy first-term bonus multiples is clearly exogenous. Bonus multiples were reduced substantially in FY 1976 due to pressures to reduce the budget and because of declining force size. In addition, many ratings not receiving the Selective Reenlistment Bonus (SRB) after 1974 suffered an implicit bonus reduction due to phasing out of the Regular Reenlistment Bonus (RRB).

ratings than in the non-sea-going ratings.<sup>1</sup> Although there are some exceptions, the Rodney et al. results are reasonably similar to those of Warner-Simon.

What don't we know about the effect of pay on FTRR? First, we do not have any solid evidence on the differential effectiveness of lump-sum versus installment bonuses. Conventional wisdom is that because young people have high discount rates (see Gilman, [18]) lump-sum bonuses should have a larger effect on FTRR. Since the Navy began paying lump-sum bonuses in April 1979 for the first time since the early 1970s, we now have some data available for analysis of the differential effectiveness of lump-sum versus installment bonuses.

Second, we have very little empirical evidence about how FTRR would be affected by pay changes beyond the second term. Various analytical models suggest that pay increases beyond the second term will either have no effect or only modest effects on FTRR.<sup>2</sup> Though the conventional wisdom is that variations in pay beyond the second term (e.g., a reduction in retirement benefits) would have little or no effect on FTRR, we have no empirical evidence to support it.

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<sup>1</sup>While these findings have intuitive appeal, some inconsistencies require further investigation. In addition, the results for the low responsiveness groups may, in fact, reflect the simultaneous equations problem mentioned earlier.

<sup>2</sup>See results from the annualized cost of leaving (ACOL) model of Warner [19] and results from an alternative model developed by Gots and McCall [20] and simulated by Warner [21].

In the Navy, a major nonpecuniary influence is likely to be family considerations such as the frequency of moves, family separations, and the living and working conditions in sea duty. Conventional wisdom has been that retention is negatively related to such factors, but only recently has there been empirical research on this relationship. These recent studies include those of Rodney, et al., [17], Goldberg and Warner [22], and Chow and Polich [23]. Both [17] and [22] show that first-term retention rates are negatively related to various measures of the extent of sea duty, once other factors have been controlled for. Significantly, Goldberg and Warner conclude that the negative effect of each 10 percent increase in the extent of second-term sea duty can be offset by a one multiple bonus increase. Analyzing DoD-wide data, Chow and Polich [23] show that FTRR is negatively related to the frequency of undesirable PCS moves and to being in a "rotation imbalanced" specialty. Despite the negative impact of family separations, and undesirable PCS moves on FTRR, most studies find that married people still reenlist at a higher rate than single people. These negative factors must be outweighed by the greater importance families place on job stability and the greater value of fringe benefits such as medical care.

#### Post-First-Term Reenlistments

For several reasons, research has just recently centered on post-first term reenlistments. The Navy only began paying second-term bonuses in FY 1975 and third-term bonuses in FY 1980. Estimates of



post-first term pay elasticities were not needed. More important, until recently, post-first-term retention rates were high enough that they were not a matter of concern.

Again utilizing data from the AVF era, Warner and Simon sought to estimate the effects of pecuniary factors on second-term reenlistments. They reached three major findings. First, the second term retention decision is much more a career decision than the first-term retention decision.<sup>1</sup> Second, if the whole future pay stream is increased by 10 percent, STRR will increase by between 13 and 35 percent, depending on the rating. The effect of a 10 percent increase in just third-term pay (e.g., a bonus) is smaller. A one-level bonus change will increase STRR somewhat more than FTRR. Again, with some exceptions, the pattern of second-term estimates by rating is similar to the pattern of first-term estimates.<sup>2</sup>

Their third major finding is that first-term bonuses have a negative effect on second-term retention. Bonus-induced first-term

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<sup>1</sup>That conclusion is based on the finding that retention equations estimated using a pay variable based on staying in service for a 20-year career explained much more of the variation in reenlistment propensities than did equations using a pay variable based on a short time horizon. (Failure of a model based on a short time horizon to explain the observed decline in second-term retention may be due to a tendency for civilian earnings indexes used in the analysis (earnings in manufacturing) to understate actual earnings growth.)

<sup>2</sup>Rodney et al. again obtain estimates reasonably consistent with those of Warner and Simon, although in some cases their estimates for specific ratings differ considerably.

reenlistees will have lower "tastes for service" than non-bonus-induced reenlistees, and will be less likely to reenlist after a second term.<sup>1</sup>

Kleinman and Shughart [14] previously analyzed such an effect, but their tests of this hypothesis were inconclusive. The potential link between first-term bonuses and second-term retention provides a partial explanation for the downward trend in second-term enlisted retention. In general, those personnel reaching ETS in FY 1977-78 received larger first-term bonuses than those reaching ETS in the FY 1974-76 period. In most rating groups, Warner and Simon find a statistically significant, negative relationship between STRR and the first-term bonus multiple.<sup>2</sup> Each one level increase in first-term bonus multiple is estimated to reduce STRR by between 2.5 and 3.0 percentage points. It still leads to an increase in the number (not the percent) of second term reenlistments.

Moving to nonpecuniary factors, we would again like to know how they affect retention. The major nonpecuniary explanations that have been advanced for the decline in post-first-term retention are increased sea duty brought about by falling retention and the fact that marital considerations are receiving increased weight in the decision to leave. Empirical analysis by Goldberg and Warner [22] found that

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<sup>1</sup>For rigorous developments of this hypothesis see Gotz and McCall [20] and Warner [21].

<sup>2</sup>The finding of a negative relationship between first-term bonuses and STRR has been confirmed by the work of Rodney et al. [17] and Goldberg and Warner [21].

increased sea duty per se is not the likely explanation for the decline in second-term retention rates. First, there has in fact been no real upward trend in the amount of post-first-term sea duty. Second, holding other factors constant, variation in the amount of sea duty does not explain much of the across-rating variation in second-term reenlistment rates. Rodney et al. [17] find no effect of sea duty either. The downward trend is explained by increased length of the in-port work week or other condition of work, but these factors have not been rigorously examined. For instance, anecdotal evidence suggests that Propulsion Examining Board (PEB) and other demanding inspections begun during the mid 1970s induced some people to leave. As for marital status effects, while married persons have been estimated to reenlist at a higher rate than single persons, it seems likely that sailors' retention decisions are influenced by the wife's employment status, and that the trend towards greater female labor force participation explains some of the downward trend in second-term retention.

Post-second-term reenlistment behavior is driven by the retirement system. Reenlistment rates rise from around 80 percent at YOS 10 to almost 100 percent just prior to retirement vesting. Retention rates fall sharply after retirement vesting, with less than 30 percent of those who complete 20 years of service remaining beyond 24 years of service and only about 3 percent of those who complete 20 years remaining for a full 30-year career. An important point to note is that both the structure of the retirement system and various personnel policies that encourage older personnel to leave are responsible for low

post-20-year retention. Another recent factor encouraging retirement immediately upon completion of 20 years of service is that active duty cost-of-living raises have been smaller than retired pay cost-of-living raises.

#### DEMAND

The Navy pseudonym for demand is "requirements." Official requirements are written in terms of paygrade and rating (for enlisted personnel) or designator (for officers). The Navy also specifies an objective force profile for each rating/designator which states the desired distribution of personnel by years of service.

The Navy determines its manpower requirements for most ships and aircraft squadrons by combining a statement of the required operating capability, staffing criteria established using management engineering techniques, and the Navy standard work week. Requirements for shore establishments requirements have historically been derived from estimates by field commanders of the minimum quantity and quality of manpower needed to accomplish the assigned mission. The SHORSTAMPS program is an attempt to apply to the shore establishment a methodology similar to that used for determining ship and squadron manpower requirements.

There is a wide gap between how economists view demand and how the Navy actually determines its manpower needs. Manpower "requirements" are based on engineering standards, and they tend to be viewed as fixed

and immutable. Curiously, the paygrade distributions called for in the requirements plans for different ratings are very similar, as are the objective force profiles. This is prima facie evidence that marginal productivity/marginal cost considerations play a small role in the determination of requirements. It is my impression that personnel management considerations play as important a role as anything else. The objective force profiles, for instance, are mostly determined by the retention patterns produced with the current compensation system. They do not necessarily represent an optimal YOS distribution, only the distribution that can be achieved with the current compensation system, personnel policies, and other constraints.

By contrast, economists think in terms of substitution possibilities. The optimal levels of different labor inputs depend on relative (marginal) productivities and relative (marginal) costs. Different inputs should be traded off for one another until the optimal input mix is found according to the principles discussed in the introduction. One problem that makes analysis of the demand side of the Navy manpower market extremely difficult is the likely strong interaction between complexity of equipment and the relative productivities of different personnel. It is generally believed that the introduction of more sophisticated equipment raises the productivity of high-quality personnel relative to the productivity of low quality personnel and hence raises the relative requirement (demand) for high-quality personnel. The dependence of personnel productivity on equipment complexity demand analysis extremely difficult, especially in

an environment characterized by rapidly changing technology.<sup>1</sup> With this in mind, let me turn to what we know about demand.

### Experience

It is useful to know how productivity grows with experience and the rate at which first-term personnel can be substituted for careerists, keeping readiness constant. We also need to answer questions about careerists. What is the rate at which younger careerists (e.g., second-termers) can be substituted for older careerists (e.g., YOS 10-20 careerists)? Is substitution even possible among personnel with different experience levels? Does the productivity of post-20-year personnel really decline? If so, in what jobs? Recent studies that address these questions include Horowitz and Sherman [24] and Albrecht [25].

Horowitz and Sherman analyze the productivity of maintenance personnel in six ratings (BT, MM, FT, GM, ST, and TM). Using a sample of 91 ships, they related the downtime of equipment maintained by personnel in those ratings to personnel characteristics and various other determinants of ship condition. They conclude that equipment on ships with higher manning levels is in general better maintained -- personnel marginal productivity is positive. But, the contribution of higher overall manning compare to improved crew characteristics (holding

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<sup>1</sup>In the economist's jargon, the production function is not separable between aggregate capital inputs and aggregate labor inputs.

manning constant) varies considerably. Variations in crew size make the most difference on ships with simple equipment; improved crew characteristics as measured by experience, paygrade, and training make the most difference on ships with more complex equipment.

The hypothesis of the interaction between equipment complexity and marginal productivity of different labor inputs is borne out by [24]. A particularly interesting finding was that in the ST rating, time at sea rather than total service experience was the experience factor most related to downtime. One other important result is that the manning level of high grade enlisted personnel (E8 and E9) was almost always associated with reduced down time, even on less complex equipment. This finding was surprising because E8 and E9 personnel are supervisors, not technicians. This finding indicates that the Navy may not have enough high grade enlisted billets (currently E8-E9 billets are only 3 percent of total enlisted billets).

While done using Air Force data, the study by Albrecht [25] provides confirmation of some of the results of [24]. It is also important because of its methodological advances. For 17 different Air Force Specialty Codes (AFSCs), Albrecht estimates the marginal rate of substitution (ratio of marginal productivities) of careerists and first-termers. The ratios range from 1.45 to 2.25 [25, table 11]. That is, at the current input mix observed in the 17 different AFSCs studied, additional careerists add between 1.45 and 2.25 times as much to output as additional first-termers. Generally speaking, careerists were found

to have higher (relative) marginal productivities in higher skill AFSCs. This study is useful both because most of the AFSCs analyzed have Navy counterparts and because it further illustrates that there are substitution possibilities between personnel with different experience levels.

### Training

There seems to be less conclusive evidence on the effects of training. Regarding training, we would like to know (1) what is the relationship between training and productivity (readiness), (2) what form of training is more effective, formal training or on-the-job training (OJT), and (3) when should training be given, both to maximize the effectiveness of the training, and to enhance retention incentives? Results from [24] were mixed, yet provide some answers to the first question. In some of the ratings analyzed, some measure of training (number of schools attended, number of NECs attained) was inversely related to downtime. Yet, in two ratings (MMs and GMs) downtime was positively and significantly related to one measure of training — the number of schools attended. This should not be interpreted as meaning that in these ratings training is perverse — these results are probably due to the particular sample or other intervening factors not adequately controlled for. While this study at least provides some evidence that training does matter, I don't think the results tell us much more than that. The estimated effect of training is highly variable, and it would be hard to generalize to other ratings.



Turning to OJT, the only study of which I am aware that compares the effectiveness of formal schooling and OJT is Weiher and Horowitz [26]. This study found that recipients of formal A-school training usually reach the E-4 competence level considerably faster than OJT recipients. If supervisory time has an opportunity cost, formal training is generally more cost-effective. Since the Weiher-Horowitz study is now almost 10 years old, and since there has not been much work on the optimal mix of formal training and OJT, perhaps more work should be done in this area.

Most personnel receive the bulk of their training when they first enter service. This is one reason why first-term attrition is so costly. Despite this, analyses of alternative training strategies and the optimal timing of training, including the large-scale NEOCS study of about 10 years ago, have been inconclusive. The optimal timing of training, like the mix between formal training and OJT, is an issue that deserves further analysis.

#### Personal Attributes and Productivity

Perhaps the most controversial productivity issue is the relationship between productivity and personnel quality, as measured by attributes such as high school degree status and mental group. Most pronouncements of the failure of the AVF are made on the grounds that the Navy and the other services need high quality recruits, but only low quality recruits have been attracted. Despite these contentions, the

empirical evidence of the effect of personnel quality on productivity is scant. Some evidence exists may be gleaned from the attrition research cited above [9-12], the Horowitz-Sherman study [24], unpublished work by Gay cited by Cooper [27, table 8-7], and the Gates Commission studies by Sullivan [28], and Reaume and Oi [29]. The studies by Horowitz and Sherman and by Gay are generally consistent with findings of attrition studies. First, high school degree status is the factor most correlated with productivity, especially in medium and low skill jobs.<sup>1</sup> Second, while there are differences in productivity according to mental group, these differences are most pronounced in high skill jobs. Gay estimates that in high skill jobs the difference in productivity between mental group I and mental group III high school graduates is 18 percent. For medium and low skill jobs, the difference is estimated to be only 6 percent. Importantly, differences in productivity by high school status and mental group are decidedly smaller than productivity differences by experience level.

It is not clear from these analyses what the optimal force mix is or how it has changed over time. Gates Commission work by Sullivan and Reaume and Oi suggests that the services tend to overstate their quality requirements. This conclusion was based on an occupation-by-occupation comparison of the mental group and educational mix of military and

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<sup>1</sup>Cooper [27, table 8-8] estimates that about 71 percent of Navy jobs are in medium skill and low skill jobs (44 percent and 27 percent, respectively). Twenty-nine percent of Navy jobs are high skill jobs, the largest of the four services. This breakdown of jobs by skill level is based on FY 1974 data.

civilian labor forces. Whether such a conclusion would be warranted today is debatable.

#### Productivity Differences According to Sex

Despite much debate, we have little evidence on productivity differences according to sex. I expect that in many ratings women may be more productive than men. The women being accessed today certainly have better attributes as measured by high school diploma status and mental group. The Navy's reluctance to take more women stems from three factors — tradition, lack of evidence about the relative productivity and costs of women, and the need for a shore rotation base for men. The legal prohibition against using women on combatant ships is another factor to be considered. Yet, there are many ratings where the extent of sea duty is low (e.g., YN, HM, DT), and these are precisely the ratings for which one wouldn't expect women to be any less productive than men. On the cost side, however, women have somewhat higher attrition and lower retention rates than men and they may be more expensive in other ways (e.g., higher costs for medical care and housing).

### General Observations

Having reviewed the "state of the art" concerning Navy labor supply and labor demand, let me turn to one of the themes of this paper — that the tools for analyzing optimal force mixes are underdeveloped. Such tools require integrating our knowledge of labor supply with what we know about labor demand. Seven years ago, Jaquette and Nelson [30] specified a model for analyzing optimal force mixes. Later, Albrecht [25] and Gotz and Roll [31] applied this model to the other services. Yet, such an integrated model has not yet been developed or applied to Navy manpower problems.<sup>1</sup> Clearly, development of an integrated manpower planning and analysis model for the Navy should be given high priority in future research.

Despite the fact that a model for analyzing the optimal force mix is undeveloped and that the marginal productivities of various quality personnel have not been precisely estimated, I think that exercise of such a model would reach the following conclusions. First, the Navy needs more careerists. The price of first-termers relative to careerists rose considerably with the advent of the AVF, and the relative productivity of careerists rose in those skill areas where more

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<sup>1</sup>For want of a better place to discuss it, the work of Waterman, Maurer, and Huntzinger [32] should be mentioned here. They build a model of the requirements for personnel by sea and shore billets and derive the equilibrium sea-shore rotation pattern for different retention rate patterns. While this model has not been used much, it would be an extremely useful tool for evaluating the cost-effectiveness of alternative mechanisms for increasing sea manning, including sea pay.

complex equipment has been adopted. Both of these facts indicate that the Navy enlisted force should become more career-intensive, yet the careerist fraction has risen only slightly since the end of the draft.

While the Navy's career force is too small, attempts to build it up should be aimed at increased manning in the 5-10 year range and in the post-20 year range rather than the 11-20 year range. This conclusion is based on the following considerations. To begin with, the marginal cost of a second or third-term reenlistee is 3 to 5 times as high as the marginal cost of a first-term reenlistee. These differences in marginal cost exist because the Navy is a monopsonist (it must raise pay to get more reenlistees) and the fact that base retention rates (those that would prevail without a pay increase) are much higher at the second and third-term reenlistment points. Hence, much more of the pay increase (e.g., reenlistment bonuses) focused at the second or third-term reenlistment points is paid to personnel who would have stayed without the pay increase than at the first-term point. That is, at later terms much more of a pay increase is pure "rent" received by "intramarginal"

reenlistees.<sup>1</sup> While the cost of an extra second or third-term reenlistee is 3 to 5 times higher than the cost of an extra first-term reenlistee, it is unlikely that productivity is commensurately higher. Thus, in attempting to expand the career force, there would be a higher payoff to focusing pay increases at the first-term reenlistment point than at later points.<sup>2</sup>

As for increasing retention of post 20 year personnel, the marginal cost of keeping them is low, primarily because the value of retirement benefits grows very slowly with years of service past 20. The cost of keeping someone from the 20 to 30 year point is considerably lower than the cost of keeping someone from the 11 to 20 year point. Further, what evidence there is (e.g., [24]) suggests that 21 to 30 year careerists are no less, and probably more, productive than 11 to 20 year personnel. More post-20 year personnel could be obtained by relieving

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<sup>1</sup>Economists will note that the marginal cost I am talking about here is marginal budget cost not marginal social cost. The marginal social cost is the pay received by the marginal reenlistee. Marginal budget cost exceeds marginal social cost by the rent received by intramarginal reenlistees; this rent is simply a pure transfer from taxpayers to intramarginal reenlistees. While economists will argue that rents should be ignored and that the optimal force mix should be based on marginal social costs of different inputs, I would like to point out that (1) with a fixed Navy budget, rents are a real cost to the Navy because it must give up something to pay them, and (2) rents are not really pure transfers because the higher taxes that must be levied on taxpayers to raise military pay will distort private sector resource allocation.

<sup>2</sup>This suggests that recent large hikes in second and third-term bonuses may have been misguided.

restrictions on the number of high grade personnel and, most important, by changing the retirement system. The latter issue is addressed below.

#### POLICY ISSUES

As stated at the outset, personnel and compensation policies are the mechanisms by which supply and demand are equated. From an economist's point of view, the management problem is to find the least cost combination of personnel and compensation policies that will generate a force of specified capability. That is, the management problem is to find the most efficient mix of compensation and personnel policies. Yet, there are frequently other objectives that conflict with the efficiency objective, most often the objective of equity in the compensation and personnel systems. Equity and efficiency considerations frequently conflict and there is a considerable difference of opinion between economists and policymakers on how much weight should be given to efficiency and equity. (See Okun [37] for a general discussion of efficiency vs. equity issues.) The evidence is that equity considerations frequently prevail.<sup>1</sup> In addition, other general social issues may become important, such as the need to maintain a racially balanced military force.

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<sup>1</sup>As an example, the recent Navy position to raise flight pay for Naval Flight Officers (NFOs) as well as pilots, even though there is no NFO retention problem.

I shall discuss compensation policy first, and then consider other personnel policies.<sup>1</sup> In my view, these are the major compensation issues:

- o The proper mix of enlistment incentives
- o The need for more flexibility in the compensation system
- o The need for better advancement and performance incentives
- o The proper mix of direct cash compensation and in-kind benefits
- o The structure of the retirement system.

#### The Proper Mix of Enlistment Incentives

How high should first-term pay be set? What is the appropriate mix of first-term pay, enlistment bonuses, and educational incentives? Should we return to the GI Bill? What is the appropriate mix of compensation incentives versus extra recruiting resources? Answers to these questions depend crucially on the desired quality mix of accessions and on other considerations such as the "spillover" benefits

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<sup>1</sup>Many of the compensation issues have been previously discussed by Cooper [27, 33], the Defense Manpower Commission or DMC [34], the President's Commission on Military Compensation or PCMC [35], and Binkin and Kyriakopoulos [36].



of educational expenditures and the benefit of a socially more representative force.

Supporters of various policy alternatives fall into two groups. One group, led by Moskos [38], believes that the elimination of the GI Bill and the increased emphasis on up-front cash incentives such as higher pay and enlistment bonuses were mistakes. It was a mistake because high mental group personnel are much more responsive to changes in educational incentives than active duty pay, such that high mental group accessions fall in the face of elimination of GI Bill benefits and an increase in active duty pay.

The argument in favor of returning to the GI Bill implicitly assumes that the Navy, and the other services, don't have enough high quality accessions and that the GI Bill is the only incentive short of a return to the draft that will induce high quality individuals to enlist. Further general social benefits derive from a return to the GI Bill: a socially more representative force (a high proportion of upper mental group accessions are white) and more human capital formation.

The other group, mostly economists, see the GI Bill as an expensive enlistment incentive and who argue that the same accession mix, or an alternative accession mix of equal effectiveness, can be had more cheaply via other policy tools. According to this group, even given the uncertainty in the estimates of the effect of recruiters and advertising the marginal accession cost of these tools (or a general first-term pay raise) is considerably lower than the marginal accession cost of higher

educational benefits. This group further favors using enlistment bonuses rather than GI Bill benefits on the grounds that (1) enlistment bonuses can be targeted to ratings for which shortages exist whereas GI Bill benefits would normally accrue to all enlistees, and (2) young people discount future compensation highly, so that a smaller up-front enlistment bonus will provide the same enlistment incentive as a large amount of deferred educational benefits. This group also emphasizes the negative effect of the availability of GI Bill benefits on reenlistments.

A second point of attack against returning to the GI Bill is a belief that the services currently misallocate many of their high quality accessions, and a belief that there are many high quality alternatives available at lower cost. First, many high quality personnel end up in jobs where lower quality personnel perform quite adequately (i.e., where productivity differences are small). Second, even if the services insist on high quality personnel, they could meet their quality needs by taking more women, who are in excess supply at current pay levels.

Despite the rhetoric from both groups we are nowhere near consensus on these issues. Strictly on grounds of efficiency, the economists are probably right. When general social benefits due to a GI Bill are added in, the scale may be tipped the other way, although I am skeptical. O'Neill and Ross [39] found significant human capital effects of GI Bill training. The social benefit of a more representative force may be

significant, however hard it is to evaluate. Returning to the GI Bill would at least be preferable to returning to the draft. Further, a reactivated GI Bill that corrects many of the deficiencies of the old one could be designed.<sup>1</sup>

#### The Need for More Flexibility in the Compensation System

As stressed by the PCMC, one of the glaring deficiencies in the compensation system is its inflexibility. There is only one pay table for all ratings, and the reenlistment bonus is the only major discretionary policy tool. Until the start of FY 1981, special pays such as sea pay and submarine pay were so small as to be meaningless. Even with the recent increase in sea and submarine pay rates and the introduction of a Variable Housing Allowance (VHA), outlays for bonuses and other special pays (including VHA) were only 11.8 percent as much as outlays for basic pay and allowances. That is, almost 90 percent of enlisted compensation is in the form of non-discretionary items. The non-variable percentage is even higher in other services.<sup>2</sup>

The inflexibility in the military compensation system is a problem because supply and demand conditions vary considerably across military

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<sup>1</sup>Note that recent substantial reductions in funding for CETA and direct college loan aid coupled with higher military pay should have a significant positive effect on accession supply, perhaps enough to eliminate the need for a return to the GI Bill.

<sup>2</sup>Interestingly, VHA is primarily a Navy program, and it increased inter-service pay differentials.

occupations and the tools for adjusting pay to accommodate these differences are underutilized. The military has usually favored general pay raises to solve retention problems. The problem with general pay raises is that they inevitably end up paying more than is necessary to retain personnel in skills and/or length of service cells where shortages don't exist (i.e., these personnel earn rents). General pay raises can be very expensive because they increase the costs of other pays linked to basic pay, most importantly, retired pay. Economists, on the other hand, favor the use of more flexible compensation tools, including reenlistment bonuses, multiple pay tables, and expanded use of special and incentive pays.

Most analysts, I think, prefer expanded use of reenlistment bonuses. Bonuses are the most flexible of the options cited, and they need only be paid at career points where retention is a problem. Use of bonuses rather than general pay raises minimizes the "rent" paid to intramarginal personnel (i.e., those who would have stayed without the pay raise). Contrary to popular belief, the bonus has been an underused policy tool. Until the sizable increase in bonus funds in FY 1981, the average selective reenlistment bonus (SRB) multiple in the Navy was less than 2. For several years many of the CREO category A ratings (ratings with the largest career manning shortfalls) still only received level 2 or 3 bonuses. Even a level 6 bonus (capped at \$20,000) represents less than a 30 percent increase in total compensation over the horizon of a

reenlistment.<sup>1</sup> While \$20,000 is a lot of money, it represents a much smaller percentage pay increase than normally thought. By this view, then, most of the Navy's retention problems could be solved simply by expanded use of bonuses. I should add that most analysts favored the recent switch to lump sum bonuses because these would have a larger retention effect than installment bonuses.<sup>2</sup>

Though expanding the use of bonuses has a lot of merit, several arguments have been advanced against their expanded use. First, bonuses -- especially lump-sum -- are not a highly visible element of compensation and surveys show that personnel tend to forget about their compensation level. Second, there is the fear (somewhat paternalistic) that most lump-sum bonus recipients blow the money on a new car and then spend the next several years starving (and regretting that they reenlisted). This argument suggests that lump-sum bonuses may have a detrimental effect on subsequent job performance.

A way to alleviate these problems (to the extent that they are problems) would be to incorporate bonuses into the monthly pay check and base each month's payment on the individual's current basic pay. Such a

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<sup>1</sup>This is the bonus as a percentage of the RMC stream over the horizon of a reenlistment, where the RMC stream reflects both longevity and expected promotion increases.

<sup>2</sup>Lump-sum bonuses should have a larger effect than equivalent installment bonuses for two reasons. The first is due to the fact that personnel have non-zero discount rates. Second, since bonuses are now based on paygrade at reenlistment, inflation reduces the real value of the future, fixed installments.

system would increase the visibility of bonus payments, reduce or eliminate the effect of inflation on fixed installment payments, and increase the incentive to perform and advance.

There are several technical problems with the bonus program. The first is that, over time, the fixed legal maximums or caps on bonus payments induce personnel to reenlist for shorter periods. Even with the recent increase in these caps, personnel in ratings receiving level 5 or 6 SRBs may reach the cap with only a three or four year reenlistment.<sup>1</sup> In my view, the caps should be eliminated. Another change would be to graduate the bonus multiples according to the length of reenlistment. (This is now done for doctors.) It would increase the incentive to reenlist for longer periods.

A second problem is that current policy discourages reenlistments of 6-year-obligors in non-nuclear fields. Unlike nuclear-trained personnel, only the period of additional commitment counts toward a bonus. Reenlistees in their fourth year of service will thus get

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<sup>1</sup>Prior to FY 1980, the maximum reenlistment bonus was \$15,000 for nuclear trained personnel and \$12,000 for non-nuclear-trained personnel. Since then, they have been \$20,000 and \$16,000, respectively.

smaller bonuses than 4-year obligors receiving the same SRB multiple.

This policy is unfair if not inefficient.<sup>1</sup>

An alternative to expanded use of reenlistment bonuses is multiple pay tables. That is, each rating could have a separate pay table, and the table could be adjusted as supply and demand conditions dictate. Multiple pay tables have recently been advocated by Binkin and Kyriakopoulos [36]. The services have objected to them on grounds that they would be unwieldy and that personnel can not be certain what their pay is going to be. No less a flexible compensation advocate than Cooper [33] casts doubt on the viability of multiple pay tables.<sup>2</sup> A system of multiple pay tables need not be as unwieldy as imagined. Occupational differentials could be introduced simply as multiples of the current basic pay table, much like bonuses are. In fact, the revisions to the bonus program suggested above, namely returning to monthly bonus payments based on the current month's paygrade, is, in effect, a multiple pay system. Legislative authority to award up to \$150 per month in proficiency pay to personnel in shortage specialties

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<sup>1</sup>During the Variable Reenlistment Bonus (VRB) program period, early reenlistees did get credit for time left on their current enlistment contract in their bonus calculation. Such credits were eliminated when the SRB program was introduced on the ground that it was inefficient to pay twice for already obligated time. While this may be true for 4-year obligors, it is probably inefficient not to give such credit to 6-year obligors, who are in high skill areas.

<sup>2</sup>He does so on grounds that multiple pay tables would be unwieldy and that the services would strive to avoid pay inversions, even if there was an excess supply of personnel at the higher experience levels. A major problem some might see with multiple basic pay tables is that retirement benefits would vary considerably by occupation.

now exists, although recently only nuclear-trained petty officers have received it. This legislative authority represents another easily administered vehicle for varying pay by occupation.

Special and incentive pays offer another mechanism for introducing more flexibility into the compensation system. Special and incentive pays include sea pay, submarine pay, flight and carrier flight deck pay, hostile fire pay, proficiency pay for duty assignments, and diving pay. The VHA should also be considered as a special pay. As noted, in spite of the recent increase in sea and submarine duty pay and the introduction of VHA, these pays remain a small portion of the total compensation package.

In my view, sea and submarine pay remain too small a portion of the compensation package. These two pays offer incentives that the reenlistment bonus can not.<sup>1</sup> They will encourage personnel in sea going ratings to go to sea and personnel already in sea billets to stay there. In fact, the number of personnel requesting extensions to sea duty has increased substantially in the wake of the sea pay rates that went into effect on 1 October 1980. In my opinion, while the new sea pay plan is a step in the right direction it did not go far enough.

Again, the primary argument against the increased use of special pays is that these pays are themselves inflexible and that they cannot

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<sup>1</sup>Note that most of the ratings that have high sea-shore ratios are the rating with chronic shortfalls and they already are high bonus ratings.



be turned off like bonuses can if retention gets too high. My response to these arguments is that ratings that would benefit the most from higher special pays like sea and submarine pay are already high-bonus ratings. Any tendency for retention to rise too much in these ratings can be offset by cutting back on bonuses.

#### The Need for Better Advancement and Performance Incentives

In addition to its inflexibility, the military compensation system is notable for its lack of incentives for advancement and better job performance. First, current paygrade differentials are quite low, as illustrated in table 2. While there has been no formal study of the incentive effects of pay differentials by grade, these differentials appear too small to encourage better performance and advancement.

That the military paygrade differentials in general, and the E3/E4 and E4/E5 differentials in particular, are small may be seen by comparing them with the private sector differentials shown in table 3. While the differentials in table 3 are for white collar occupations included in the PATC survey, they are representative of some military jobs. I expect to find similar differentials in civilian blue collar jobs that are more representative of military jobs. That private sector employers, who face fewer constraints than the military, choose to establish much larger pay differentials by grade level, is revealing.

TABLE 2

## PERCENTAGE DIFFERENTIALS IN MILITARY PAY BY PAYGRADE

	<u>E3/E4</u>	<u>E4/E5</u>	<u>E5/E6</u>	<u>E6/E7</u>	<u>E7/E8</u>	<u>E8/E9</u>
Basic pay	4.1	2.8	9.8	9.8	12.0	13.4
RMC	4.9	5.0	9.1	9.1	12.9	14.8
Disposable income	4.4	4.5	6.9	7.9	10.4	13.7

Source: "Regular Military Compensation - October 1980 Pay Rates," OASD MRA&L), MPP. Pay differentials calculated at average time to promotion. RMC based on that of a married individual with two dependents.

TABLE 3

PERCENTAGE PAY DIFFERENTIALS IN PRIVATE SECTOR  
BY GRADE LEVEL FOR VARIOUS OCCUPATIONS

<u>Occupation</u>	<u>Grade Level</u>			
	<u>1/2</u>	<u>2/3</u>	<u>3/4</u>	<u>4/5</u>
Draftsman	21.9	22.9	—	—
Computer operator	18.2	10.5	24.2	13.8
File clerk	17.0	26.8	—	—
Secretary	9.9	13.1	9.4	—
Engineer	9.7	15.3	18.5	17.2

Source: PATC Survey, 1979

A comparison of experience-earnings profiles of military personnel with comparable civilian profiles reveals that military experience-earnings profiles are considerably flatter. This problem is really a corollary of the fact that the paygrade differentials are so much smaller in the military. The problem is illustrated in table 4. While experience-earnings profiles look similar through about 8 years of experience, they widen thereafter, with the major differences occurring in the 8-12 YOS range. Note that the civilian profile is an average across different civilian occupations. It is likely that civilian profiles are steeper in more highly skilled occupations.

Some may not consider the flatter experience profiles of military personnel to be a problem because the data cited do not include expected future retired pay. When retired pay is included, the military profile would be steeper. But, my point is that since active duty pay profiles are so much flatter than civilian pay profiles between 8 and 20 years of experience, future retired pay is the major inducement to continued service.

Aside from generally increasing the existing grade differentials, several other possibilities exist for increasing advancement and performance incentives. One is to reinstate proficiency pay (PROPAY) for superior performance. Legislative authority to award PROPAY for superior performance exists, but such payments ended in 1976. Another mechanism for providing better advancement and performance incentives is to implement a pay table that bases longevity raises on time in grade

TABLE 4  
EARNINGS OF EXPERIENCED PERSONNEL  
RELATIVE TO ENTRY LEVEL EARNINGS

	Years of Experience				
	4	8	12	16	20
Military enlisted <sup>a</sup>	130.6	160.0	168.3	188.2	211.3
Private sector high school graduates <sup>b</sup>	132.3	160.5	184.5	204.3	224.0

<sup>a</sup>Calculated from "Regular Military Compensation - October 1980 Pay Rates," Department of Defense, OASD(MRA&L) MPP.

<sup>b</sup>Predicted from work of Johnson and Hebein [40]. For high school graduates, they estimate the income growth from experience (EXP) to be  $.086 \text{ EXP} - .0013 (\text{EXP})^2$ . Substituting the values of EXP shown in the table given the values shown for private sector high school graduates.

(TIG) rather than time in service (TIS). The issue of TIS versus TIG-based pay tables was considered by the PCMC and later by OSD in its PCMC review. Service reaction against a TIG-based pay table was strong and the idea died. Yet, a TIG-based pay table would provide much stronger performance incentives than a TIS-based table and would help retention of high quality personnel (see Cooper [27]).

#### The Proper Mix of Direct Cash Compensation and In-Kind Benefits

Traditionally, much military compensation has been in the form of in-kind rather than direct cash benefits. What is the optimal mix of direct compensation and in-kind benefits? This question is hard to answer, but it points up a major difference of opinion between economists and others. High ranking military personnel and academic non-economists support a compensation system that stresses in-kind benefits and deemphasizes direct cash benefits. Thus, at the public hearings of the PCMC, the services expressed strong opposition to the adoption of a salary system. They opposed such a move on the grounds that the current pay and allowances system differentiates the military from civilian employers and that it serves to stress the "uniqueness" of military life. Academicians such as Moskos link the mix of cash and in-kind incentives to job performance, suggesting that a system heavy on in-kind benefits will attract individuals who are more "committed" to the military while a system heavy on direct compensation only attracts personnel who are "in it just for the money." The inference is that

there is a link between the incentive package and job performance, although I know of no empirical evidence bearing on this issue.

On the other hand, economists stress the negative aspects of compensation systems that are heavy on in-kind benefits. First, because in-kind benefits are not particularly visible, personnel tend to understate their total compensation.<sup>1</sup> Because they understate their total compensation, retention may be lower than it would be under a salary system.<sup>2</sup> Second, economists stress cash benefits because of the problem of diversity of preferences. Yet, despite these objections to in-kind benefits, some may be quite productive. Anecdotal evidence suggests that personnel tend to place a higher value on certain in-kind benefits (e.g., commissary benefits) than they cost to provide.

To state them formally, the issues are threefold: (1) Are retention decisions affected by different incentive packages? (2) Do different incentive packages in fact affect job performance? (3) What mix of cash and in-kind benefits meets manpower objectives at least

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<sup>1</sup>Chow and Polich [23] find that personnel tend to understate pay by as much as 30 percent.

<sup>2</sup>Chow and Polich estimate a modest retention increase to be had due to a switch to a salary system. They believe that the same retention increase can be obtained more cheaply using other tools, e.g., bonuses. A move to a salary system would be expensive because it would require eliminating the differential in pay between married and single personnel.

cost? Economists have focused most of their attention on the first question, but the other two are deserving of analysis as well.<sup>1</sup>

One issue that I would like to raise about the pay and allowance system is the pay differential between married and single personnel. The PCMC recommended against eliminating the differential, primarily on grounds of cost (several billion dollars). In my view, this pay differential is inequitable if not inefficient. The PCMC cost analysis only considered pay differences. However, if the married-single differential were eliminated and retention rates among single people raised, other indirect costs could be reduced (e.g., medical care). The married-single pay differential is an issue deserving further analysis.<sup>2</sup>

#### The Structure of the Retirement System

Much has been written about the military retirement system in the last 10 years. At least 5 proposals have been advanced to change it, the most recent being a proposal drafted by OSD after its review of the report of the PCMC [29]. Like the PCMC plan, the OSD plan provides significant cash benefits to those who complete 10 years of service,

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<sup>1</sup>The work by Chow and Polich [23] provides evidence on the effects of some in-kind benefits, primarily housing. A novel attempt to measure the value personnel place on in-kind benefits is provided by Hay Associates [41], although no attempt is made to link this valuation to either retention or job performance.

<sup>2</sup>Even if the basic differential is not eliminated, the inequity that arises because single personnel lose allowances while on deployment, whereas married personnel do not, should be.

substantially reduces 20-year benefits, but maintains 30-year benefits at about their current level. The main difference is that the PCMC plan provided much stonger incentives for personnel to complete 30 years of service.<sup>1</sup> These plans are controversial, and the services' reaction to them has been quite negative. They were viewed as attempts to cut retirement costs with nothing in return. Indeed, while the PCMC paid lip service to the need for restructuring the whole compensation system, it offered few specific recommendations other than its retirement proposal.

Despite the adverse reaction to these plans, I believe that they have merit, on two grounds. One, the current compensation system does not produce the greatest possible retention per dollar of manpower expenditure. Two, the retention pattern produced by the current system is suboptimal.<sup>2</sup> The first premise is based on empirical evidence that personnel in general, and young people in particular, have discount rates that greatly exceed the government's discount rate. The government's cost of providing future retirement benefits thus exceeds the value personnel place on them. Reallocating compensation away from retired pay and to active duty pay would raise retention among young personnel. Reducing 20-year benefits while keeping 30-year benefits at today's level would substantially increase post-20 year retention.

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<sup>1</sup>Analyses of the retention effects of these plans is contained in [19].

<sup>2</sup>Cooper [33] discusses these premises in more detail.



The premise that the current retention pattern is suboptimal is based on the idea that marginal productivity relative to marginal cost (MP/MC) is not the same for personnel with different lengths of service. Specifically, MP/MC is much lower for mid-length careerists than for either young careerists or older careerists. Hence readiness could be increased by raising the number of 5 to 10 year careerists, lowering the number of 11 to 20 year careerists and raising the number of post-20 year careerists. The OSD and PCMC plans would have precisely such an effect on the career force profiles.

#### PERSONNEL POLICIES

Aside from changing the compensation system, there are a number of personnel policy changes that might improve retention and better enable the Navy to meet its manpower requirements. Here I try to identify some, although I am sure not all, of the policy changes that might be made. Many of these changes have been alluded to above. I want to stress that much of what I have to say here is speculative since the costs and benefits of many of these potential policy changes are not fully known. First, I discuss the distinctive features of the military personnel system and then policies relating to force management.

#### Distinctive Features of the Military Personnel System

The military personnel system has many distinctive features. First and foremost, many personnel policies are geared towards maintaining

discipline and esprit de corps. The need to maintain discipline and esprit de corps obviously derives from the fact that the military mission is quite unlike any in the private sector. Historically, the need to maintain discipline and esprit de corps gave rise to a number of personnel policies that restricted individual freedom. Today, in the AVF environment, there is pressure to relax these restrictions. An important question is the extent to which such policies can be relaxed without damaging discipline, esprit de corps, and ultimately readiness.

A second unique feature of the military personnel system is that it is a closed system. The services take very few lateral entries (although in the last several years the Navy has begun to focus more of its recruiting effort on prior service individuals. Rather, they "grow" skilled personnel by accessing and training 17 to 24 year old youths. The closed nature of the system is an outgrowth of an era when most military jobs were in combat arms or other relatively unskilled jobs, where "youth and vigor" were the primary job requirements. In the closed system, all entry level personnel receive combat and initial skill training and then progress through the ranks on the basis of experience and performance.

The military operates an up-or-out promotion system designed to enhance job performance and eliminate non-performers. While an up-or-out promotion system is not unique to the military, certain aspects of the military system are. Like private sector employers, the Navy severs young personnel, who fail to perform and advance satisfactorily, usually

during or at the end of the first term of service.<sup>1</sup> Very few personnel are then severed until retirement vesting (YOS 20). The unique aspects are the fact that the services then begin to sever personnel at much earlier ages than do most private employers and that the retirement system operates as a lucrative severance pay. Mandatory retirement rules, applied to personnel in middle officer and enlisted grades, are defended on grounds of avoiding grade stagnation and maintaining good promotion opportunities for younger personnel.

These features of the military personnel system are open to question. First, are the many rules and regulations that perpetuate themselves under the guise of maintaining discipline and esprit de corps really necessary? My feeling is that many of them (e.g., haircut policies) serve only to alienate individuals who would otherwise have a favorable view of military life. As evidence of this, one only need read the letters to the editor of any issue of the Navy Times. The June 1, 1981 issue of The Times Magazine should be required reading of all personnel managers. In my opinion, the Navy and the other services can adapt to social change without necessarily losing control of its personnel or weakening the nation's military posture. At the least, there needs to be a comprehensive review of policies relating to the maintenance of discipline and esprit de corps.

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<sup>1</sup>In the last several years, there has been some relaxation of these standards. Now personnel who are not rated by the end of their initial enlistments are given a year or two to achieve petty officer status.

Second, what is the value of a closed system? While the closed system may have made sense in an era when most jobs were unskilled and simply demanded "youth and vigor," it makes less sense today. Many of today's military jobs require more skill and experience and they also have many civilian counterparts. These jobs could be opened up for lateral entry without requiring that such entrants receive combat training. There is a shift in the age structure of the U.S. population away from 17 to 25 year olds and towards 25 to 34 year olds; the Navy needs to develop personnel policies that will accommodate this age shift. At the least, it should make an effort to attract more prior service personnel and eliminate policies such as grade reduction that discourage prior service personnel from returning.

Finally, is the up-or-out promotion system worth it, especially as it operates for older personnel? Using the retirement system simply as a form of severance pay is expensive. If individuals do not perform well, they should be severed prior to retirement vesting. The practice of not severing non-performers between their 10th and 20th years of service is a disincentive to good job performance. Also, it appears that many good middle grade personnel who would like to remain in service beyond their 20th year of service are not encouraged to do so. Unless there is evidence that these persons are unproductive (in which case they should have been severed earlier), they should be encouraged to remain in service. The marginal cost of keeping these people is clearly lower than the cost of severing them and replacing them with second or third-term personnel. In my view, the Defense Manpower

Commission recommendation [34] that the services lower the flow of personnel beyond the 10-year point but keep most of them for a full 30-year career (by an appropriate restructuring of the retirement system) has a great deal of appeal. Indeed, this was the very intent of the PCMC retirement proposal.

#### Recruiting and Management of First-Term Personnel

Even though the youths most desired by the Navy — non-prior service male high school graduates in the upper mental groups — are in short supply, there is an excess supply of many other groups at current pay levels. These other groups include lower quality men (high school graduates in lower mental groups and non-high school graduates in all mental categories) and high quality women. Current recruiting practice limits the intake of lower quality males in order to reduce first-term attrition. Reasons for the policy of limiting the intake of high-quality women have been stated earlier. I suspect that, from a cost-benefit viewpoint, it would be efficient to access many more women, although this is yet to be demonstrated empirically.

As for the first-term attrition problem, one has to wonder whether limiting accessions of lower quality males is the most efficient means for reducing first-term attrition. Such a policy screens out many who would make good sailors. Programs could be established whereby potential good sailors enter the Navy on a provisional status and be allowed to stay if they perform well during boot camp. The Army and the

Marine Corps already have such programs. Because about one-third of the first-term attrition occurs during boot camp, incentives for completing boot camp could be increased. Such incentives might include giving recruits only half-pay until they finish boot camp or increasing the E1-E2 pay differential.

First-term attrition could be reduced by a variety of other policy changes. The first is improved assignment procedures for first-term personnel. The work by Thomason [12] shows that assigning personnel to ratings/ships where their attrition chances are lowest could reduce first-term attrition by about 8 percent. Such a policy may or may not be economically feasible, depending upon other costs (e.g., added PCS costs) that might be incurred to implement it.

Second, the length of recruit training, which has been reduced to 7 weeks, could be increased to 9 or 10 weeks. This would give the Navy more time to identify and counsel people who are likely to leave and it would give individuals more time to adjust to the realities of military life.

A third policy change would be to eliminate the menial tasks such as compartment cleaning that sailors perform when they first go to the fleet. Requiring that they perform menial tasks rather than what they

were trained to do is degrading and perhaps does more than anything else to deflate their enthusiasm for the the Navy.<sup>1</sup>

#### Career Force Management

The Navy's key problem in career force management is obviously how to increase retention. Mechanisms for increasing retention at all career points, but especially at the first- and second-term point and the post-20 year point need to be identified. In improving retention at any of these points, the major problem is to overcome the onerous nature of sea duty. I doubt that the answer to improved retention lies simply in reducing sea time. Achieving the Navy's stated goal of 3 years sea duty/3 years shore duty rotation ratio would be extremely costly because of the added endstrength that would be required to provide such a rotation ratio and still man the ships. Higher sea pay would be a cheaper way of improving ship manning. Rather, while keeping sea-shore rotation ratios at today's levels, better sea pay and policies that reduce the onerous nature of sea duty provide the key to improved career

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<sup>1</sup>Again, this raises the question of when to train as well as equity issues. While it may be more efficient, it may not be fair to make GENDETs clean compartments while ET strikers do not.

retention. Clearly more work needs to be done on the optimal mix of sea-shore rotation and compensation policies.<sup>1</sup>

Part of the career retention problem is not just sea duty, but the length of the home-port work week and inequities across ratings in home-port work times. Reducing the frequency of PCS moves and accommodating preferences by providing individuals with a rotation "home base" might also improve career retention. The Guaranteed Assignment Retention Detailing Program (GUARD) has had some success. As for compensation, the recent rise in reimbursement for PCS changes should have some positive effect.

#### SUMMARY

In this paper, I have reviewed what I think we know about the Navy manpower market. The main points were the following.

#### Supply

- o Accession supply is positively related to first term pay, the number of recruiters, advertising expenditures, and youth unemployment. The elimination of the GI Bill program appears to have had some negative impact on Navy recruiting.

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<sup>1</sup>Application of the model developed by Waterman, Maurer, and Huntzinger [32] would be useful here.



- o Retention is positively related to pay but inversely related to the extent of sea duty and undesirable PCS moves.

Demand

- o Productivity varies according to qualitative attributes of enlisted personnel and the differences in productivity are most pronounced in higher skilled occupations.
- o Differences in productivity between careerists and first-term personnel are larger than productivity differences by education and mental group.

Putting the two sides of the market together, the views were advanced that:

- o The careerist shortage is real. Careerists are more productive relative to their cost than first-term personnel. The major policy thrust should be to raise careerist retention.
- o Efforts to increase careerists should be focused on the 5 to 10 and post-20 year of service intervals. Careerists in these intervals are more productive relative to their cost than careerists in the 11 to 20 year of service interval.

The function of the compensation and personnel management systems is to balance supply and demand. As I see it, the major compensation and personnel policy issues are the following.

Compensation Policy

- o The flexibility of the compensation system to balance supply and demand by occupation needs to be increased. Mechanisms for enhancing the flexibility of the compensation system include expanded use of reenlistment bonuses and special incentive pays (e.g., sea pay) and implementation of multiple pay tables.
- o The major deficiency in the compensation system is sea pay. The new sea pay rates, while much improved over the old ones, are still too low.
- o There need to be better performance and advancement incentives.
- o Retired pay seems to be an inordinate portion of total compensation, and the current retirement system produces an inefficient retention pattern.

- o More research needs to be aimed at the relative effects of direct cash and in-kind compensation.

#### Personnel Policy

- o Policies that limit the intake of women and lateral entries, especially prior service personnel, need to be reexamined.
- o There needs to be a comprehensive review of policies relating to the maintenance of discipline and esprit de corps.
- o New policies aimed at reducing first-term attrition and increasing career retention were explored in the text.

While the state of the art is imperfect, considerable effort should go into integrating what we know into a comprehensive usable manpower planning and analysis model. Concurrently, effort should be devoted to determining the most efficient mechanisms for increasing career retention. This can be accomplished with currently existing models. The administration has committed itself to supporting and sustaining a volunteer military force. Military manpower managers and analysts owe it to the taxpayers to ensure that the additional compensation appropriated for this purpose is spent efficiently.

## REFERENCES

- [1] Gilman, Harry J. "Supply of Volunteers to the Military Services," In Studies Prepared for the President's Commission on an All-Volunteer Force, Volume I. Washington, D.C.: U.S. Government Printing Office, Nov 1970
- [2] CNA, Study 1073 "Recruiters, Quotas, and the Number of Enlistments," by Christopher Jehn and William F. Shughart, Unclassified, Dec 1976
- [3] Grissmer, David W. "The Supply of Enlisted Volunteers in the Post-Draft Environment: An Analysis Based on Monthly Data, 1970-1975" In Richard V.L. Cooper, ed., Defense Manpower Policy R-2396-ARPA. Santa Monica: The RAND Corporation, Dec 1978
- [4] Fernandez, Richard L. "Forecasting Enlisted Supply: Projections for 1979-1990" N-1297-MRAL. Santa Monica: The RAND Corporation, Sep 1979
- [5] CNA, Research Contribution 409, "Recruiters, Advertising and Navy Reenlistments," by Lawrence Goldberg, Unclassified, Oct 1979
- [6] CNA, Study 1168, "Enlistment Supply: Past, Present and Future," by Lawrence Goldberg, Unclassified, forthcoming
- [7] Morey, Richard "Budget Allocation and Enlistment Prediction Models for the Navy's Recruiting Command: Testing and Validation," Duke University, Oct 1979
- [8] Fernandez, Richard L. "Issues in the Use of Post-Service Educational Benefits as Enlistment Incentives" N-1510-MRAL. Santa Monica: The RAND Corporation, July 1980
- [9] CNA, Study 1086, "Success Chances for Recruits Entering the Navy," by Robert F. Lockman, Unclassified, Feb 1977
- [10] CNA, Research Contribution 425, "A New Look at Success Chances of Recruits Entering the Navy (SCREEN)," by Robert F. Lockman and Philip W. Lurie, Unclassified, Feb 1980
- [11] CNA, Research Contribution 402, "Nonparametric Methods for Estimating Recruit Survival from Cross-Section Data," by Philip M. Lurie, Unclassified, Sep 1979

- [12] CNA, Research Contribution 382, "First-Term Survival and Reenlistment Chances for Navy Ratings and a Strategy for Their Use," by James S. Thomason, Unclassified, May 1979
- [13] Grubert, Harry, and Weiher, Rodney "Navy Reenlistments: The Role of Pay and Draft Pressure," In Studies Prepared for the President's Commission on an All-Volunteer Armed Force, Volume I. Washington, D.C.: U.S. Government Printing Office, Nov 1970
- [14] CNA, Research Contribution 269, "The Effects of Reenlistment Bonuses," by Samuel D. Kleinman and William F. Shughart II, USN, Unclassified, Sep 1974
- [15] Enns, John H. "Reenlistment Bonuses: Their Impact on First-Term Retention," R-1935-ARPA. Santa Monica: The RAND Corporation, Sep 1977
- [16] CNA, Memorandum 79-1878, "An Empirical Analysis of Pay and Navy Enlisted Retention in the AVF: Preliminary Results," by John T. Warner and Bruce Simon, Unclassified, 21 Dec 1979
- [17] Rodney, David et al. "The Impact of Selective Reenlistment Bonuses Upon First- and Second-Term Retention," The REHAB Group, 1980
- [18] Gilman, Harry J. "The Determinants of Implicit Discount Rates," Unpublished paper, Arlington, VA: Center for Naval Analyses, Sep 1976
- [19] CNA, Research Contribution 376, "Alternative Military Retirement Systems: Their Effects on Enlisted Retention," by John T. Warner, Unclassified, Sep 1979
- [20] Gotz, Glenn A., and McCall, John J. "Estimating Military Personnel Retention Rates: Theory and Statistical Method," R-2541-AF. Santa Monica: The RAND Corporation, Jun 1980
- [21] CNA, Research Contribution 436, "Military Compensation and Retention: An Analysis of Alternative Models and Simulation of a New Retention Model," by John T. Warner, Unclassified, forthcoming
- [22] CNA, Memorandum 80-1294, "Sea-Shore Rotation and Retention," by Matthew S. Goldberg and John T. Warner, Unclassified, Sep 1980
- [23] Chow, Winston K., and Polich, J. Michael "Models of the First-Term Reenlistment Decision," R-2468-MRAL. Santa Monica: The RAND Corporation, Sep 1980

- [24] CNA, Study 1090, "Crew Characteristic and Ship Condition," by Stanley A. Horowitz and CDR Allan Sherman, USN, Unclassified, Mar 1979
- [25] Albrecht, Mark J. "Labor Substitution in the Military Environment: Implications for Enlisted Force Management," R-2330-MRAL. Santa Monica: The RAND Corporation, Nov 1979
- [26] CNA, Professional Paper 83, "The Relative Costs of Formal and On-the-Job Training for Navy Enlisted Occupations," by Rodney Weiher and Stanley Horowitz, Unclassified, Nov 1971
- [27] Cooper, Richard V.L. "Military Manpower and the All-Volunteer Force," R-1450-ARPA. Santa Monica: The RAND Corporation, Sep 1977
- [28] Sullivan, John A. "Qualitative Requirements of the Armed Forces," In Studies Prepared for the President's Commission on An All-Volunteer Armed Force, Volume I, Washington, D.C.: U.S. Government Printing Office, Nov 1970
- [29] Reaume, David, and Walter Oi, "Educational Attainment of Military and Civilian Labor Force," In Studies Prepared for the President's Commission on An All-Volunteer Armed Force, Volume I Washington, D.C.: U.S. Government Printing Office, Nov 1970
- [30] Jaquette, David L., and Nelson, Gary R. "The Implications of Manpower Supply and Productivity for the Pay and Composition of the Military Force: An Optimization Model," R-1451-ARPA. Santa Monica: The RAND Corporation, Jul 1974
- [31] Gotz, Glenn A., and Robert Roll. "The First-Term Career Mix of Enlisted Military Personnel," a supporting paper prepared for the Defense Resource Management Study, Feb 1979
- [32] CNA, Research Contribution 380, "The Aggregate Sea/Shore Rotation Model (MOSES)," by LCDR R. J. Waterman, USN, Donald Maurer, and R. LaVar Huntzinger, Unclassified, Mar 1979
- [33] Cooper, Richard V.L. "Military Compensation Policy," WD-159-MRAL. Santa Monica: The RAND Corporation, forthcoming
- [34] Final Report of the Defense Manpower Commission, Washington, D.C.: U.S. Government Printing Office, 1976
- [35] Report of the President's Commission on Military Compensation, Washington, D.C.: U.S. Government Printing Office, Apr 1978
- [36] Binkin, Martin, and Kyriakopoulos, Irene. Paying the Modern Military, Washington, D.C., The Brookings Institution, 1981

- [37] Okun, Arthur. Equity and Efficiency. Washington, D.C.: The Brookings Institution, 1971
- [38] Moskos, Charles C. Jr. "Serving in the Ranks: Citizenship and the All-Volunteer Force." Paper presented at the Hoover-Rochester Conference on the All-Volunteer Force, Stanford, Cal., Dec 13-16, 1979
- [39] CNA, PRI-312-76, "Voucher Funding of Training, A Study of the GI Bill," by David O'Neill and Sue Goetz Ross, Unclassified, Oct 1976
- [40] Johnson, T., and Hebein, F.J. "Investment in Human Capital and Growth in Personal Income 1956-1966." American Economic Review (Sep 1974):
- [41] Hay Associates." Field Test of the Perceived Value of Military Benefits (Interim Report), A report submitted to OASD(MRA&L), Sep 1979

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- PP 211  
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Dismukes, Bradford and Petersen, Charles C., "Maritime Factors Affecting Iberian Security," (Factores Maritimos Que Afectan La Seguridad Iberica) 14 pp., Oct 1980, AD A092 733
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- PP 298  
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